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ACTIVITIES BULLETIN. OHIO RIVER POLLUTION SURVEY. VOLUME 2, NUMBER 6, NOVEMBER-DECEMBER 1940

Sanitary Engineering Center
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ACTIVITIES BULLETIN

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OHIO RIVER POLLUTION SURVEY

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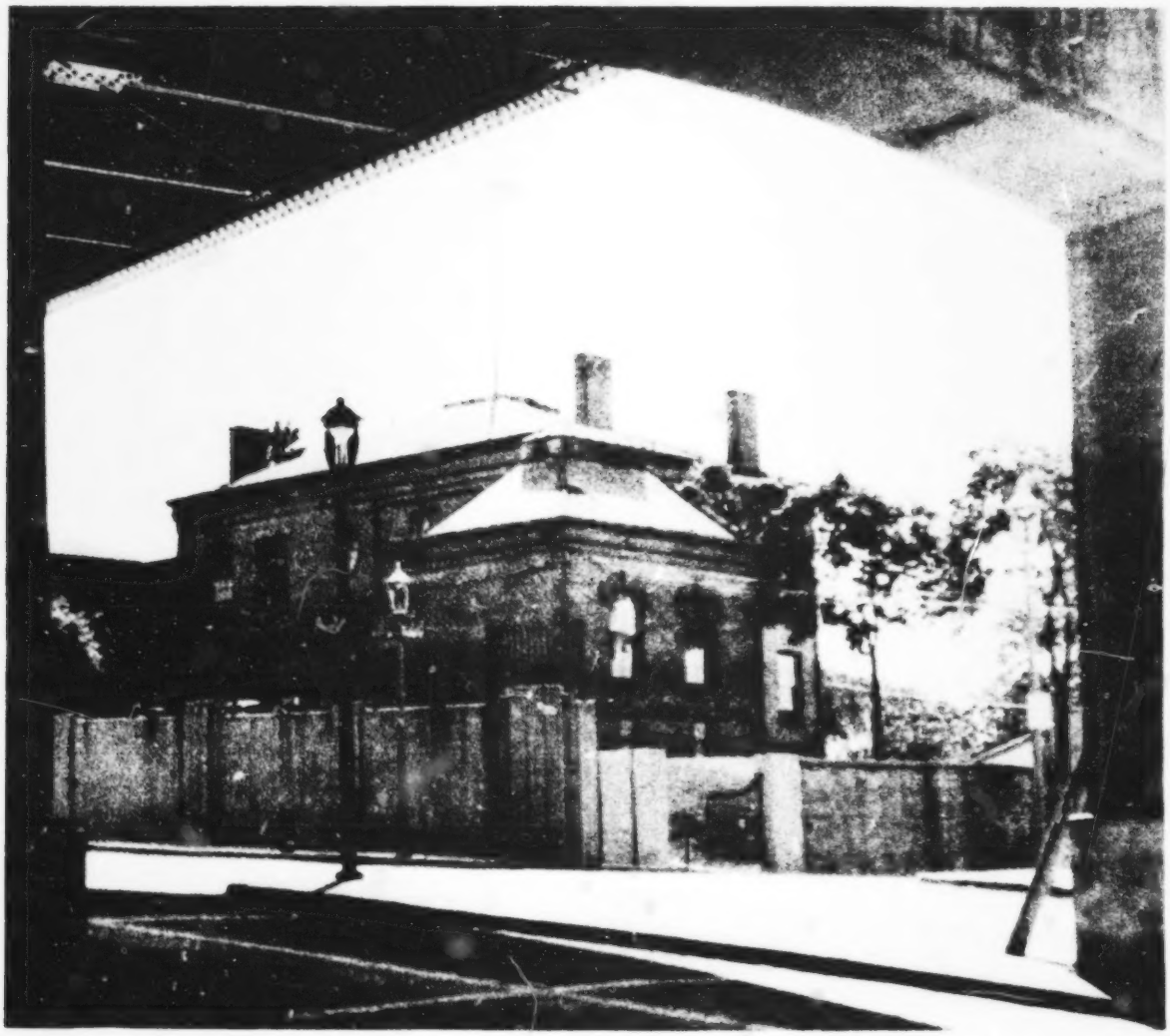

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- AN HISTORIC SPOT IN CINCINNATI -

In Civil War Days	- - -	The "Kilgour Mansion" on the Ohio
1885 - 1906	- - -	A unit in the Marine Hospital Service
1913 - 1941	- - -	U. S. P. H. S. Stream Pollution Investigations Station
1938 - 1941	- - -	U. S. P. H. S. Laboratory Hdqts. Ohio River Pollution Survey

NOVEMBER - DECEMBER - 1940

28

CONTENTS

November - December - 1940

	Page
The Survey-In Perspective-After Two Years	2
Activities at Field Sub-stations	8
Current Laboratory Operations	10
Epidemiological Studies	12
Industrial Wastes and the Ohio River Pollution Survey	14
Industrial Waste Treatment	16
Low Flow Control Measures in Operation and Proposed in the Upper Ohio Basin	19
Excerpts from Mr. Rait's Paper - Water Quality Control	19
Excerpts from Mr. Waring's Paper - Mahoning River Low Water Control	22
Stream Pollution Studies in the Pacific Northwest	27
Acid Mine Drainage Studies	27

THE SURVEY-IN PERSPECTIVE-AFTER TWO YEARS

The field work of the second season of the Ohio River Pollution Survey is closing. Laboratory work has been sharply curtailed. Field workers investigating sources of pollution will be greatly reduced early in 1941. The majority of the staff retained will be located at the Cincinnati headquarters to complete the final report.

Mr. Streeter phrased concisely the objective of the Survey as follows, in speaking to the engineers at the 1939 Ohio Conference on Sewage Treatment: "The data thus collected, when finally assembled and analyzed, will provide the foundation for a comprehensive engineering plan of stream sanitation for the Ohio River drainage basin".

It may be worthwhile to note briefly some of the trends which are becoming apparent as this Survey draws to a close:

(1) The joint stream pollution survey by the U. S. Army Engineers and the U. S. Public Health Service, assisted by many other federal and state agencies concerned with water uses and water control, has already indicated the widespread benefits of cooperative action. The many water uses in a large drainage basin like the Ohio include: navigation, public and industrial water supplies, flood and low water control, waste disposal from industries and cities, recreation and aquatic life. It appears quite probable that new technics of water pollution analysis and control may develop from the different agencies working together in this two-year period.

(2) The rapid assembly of pollution data in nearly 8,000 detailed reports now on file in the Cincinnati office from the activities of field engineers operating at State health department offices and with the Tennessee Valley Authority, has demonstrated the wisdom of working with States in stream pollution matters in the same manner as has been followed successfully in the past in all public health activities of the Service.

The detailed data on water supply and sewage disposal practices in 3,219 communities and on pollution loadings of the streams at 1,533 large industrial plants has been assembled quickly, accurately and efficiently by drawing on the sanitary engineering reservoirs of information of fourteen states in the basin and in the files of the Tennessee Valley Authority.

(3) Over 121,000 water quality determinations through the services of the several types of laboratory units - the Stream Pollution Investigations Station at Cincinnati, the floating laboratory "Kiski" and the six auto trailer laboratory units - have given the necessary water quality information on streams in the vicinity of sewage and industrial waste discharges throughout the extensive Ohio Basin.

(4) Hydrometric data on all streams in the basin under high and low flow conditions have been made available, tabulated and analyzed by the U. S. Army Engineers. Times of flow under varying conditions, both on the main stream and important tributaries, have been studied. Records over long time periods, not only from the Cincinnati headquarters office but also from the

five district offices of the Engineer Corps, have been supplemented by the U. S. Geological Survey hydrometric reports.

In addition to obtaining essential records on critical low flows in the streams, an analysis of the possibility of supplemental low flow from existing and proposed flood control reservoirs is being made through the joint efforts of these two federal agencies charged by Congress with the injunction to determine the most practical means of improving stream sanitation.

(5) Special taste and odor surveys on the Kanawha Basin in West Virginia and on the Mahoning Basin in Ohio and Pennsylvania have been made possible by the use of the trailer laboratories during the winter months, with the personnel of the trailers and the engineers of the State Health Department in question joining forces. These laboratory surveys, carried on in cooperation with the industries in the area affected, have materially assisted the State health authorities in determining the origins of objectionable tastes and odors harming downstream water supplies. An encouraging element has been the practical accomplishment brought about by the States in both cases. Industry has expended substantial funds for equipment to remedy the trouble and prevent any further discharge of objectionable wastes into the streams.

(6) With nearly 2,000 large industrial plants discharging liquid wastes into the Ohio and its tributaries, ways and means have been devised for determining the population equivalents for the many kinds of industrial wastes in the Basin. In cooperation with the Tennessee Valley Authority and with the cities of

Louisville and Cincinnati, intensive studies on textile, chemical, leather, paper and distillery plants have been successfully completed. The T.V.A. and these two large cities contributed substantially in the practical program of gaging and analyzing industrial wastes, which was carried on by joint field forces.

In addition to this field work, thirteen industrial waste guides covering practices of manufacturing, treatment methods and population equivalents in terms of units of production, have been completed at the Cincinnati office. These data are essential for the preparation of the final report.

The Survey has given a stimulus to stream pollution control activities in Tennessee where proposed legislation is now under consideration. At Louisville, the Consulting Engineers for the Sewerage Commission have recently completed their report which outlines methods and costs for sewage disposal. At Cincinnati the plans for the first unit in the sewage disposal program have been approved by the State of Ohio and construction started. In Pittsburgh, in the Upper Ohio Basin, a preliminary study and report has been completed on proposed methods of treatment and costs. In the Ironton-Ashland-Huntington area, no definite plans for a remedial program are in sight. Critical conditions from a public water supply standpoint prevailed in this tri-state area in 1939.

(7) Another practical accomplishment of this two-year survey has been the evaluation of the magnitude of acid mine drainage. This was made possible by working with the Pittsburgh

Regional Office, U. S. Public Health Service, on the Sealing Abandoned Coal Mines program. The magnitude of acid loads on the Allegheny, Youghiogheny and Monongahela Rivers, which in these three streams exceeds 110 tons per year of concentrated acid per square mile of drainage area, has been determined. Thanks to the assistance of the Pittsburgh district office of the Engineer Corps, the industries and plants using water in this area, an evaluation of the damages of acid mine drainage has been obtained. This is the first time that the acid mine drainage loads on the streams of the entire Ohio Basin, together with the reductions due to sealing abandoned mines, have been assembled and evaluated.

(8) At the request of the Division Engineer, Ohio River Division, memorandum reports are being prepared covering desirable supplemental low flow for pollution control below several proposed reservoir projects on tributaries of the Ohio River. These reports set forth useful and desirable supplemental low flows for pollution abatement and include estimates of tangible monetary benefits that accrue from such regulation.

It is anticipated that memorandum reports of this type will be developed for all proposed major reservoir projects on streams where additional water is needed during the low flow periods.

(9) A thorough investigation has been completed into the administrative procedures and practices in connection with pollution abatement in the states throughout the Ohio Basin.

This is the first detailed analysis of existing state stream pollution laws, the state machinery available for pollution abatement and the relative success of different methods of stream pollution control. It is evident that some of the systems in use by the states possess peculiar desirable attributes because of the different measures of success achieved. Analysis is included of the proposed Ohio Valley Water Sanitation Compact designed to assist in regional stream pollution control.

(10) During 1939 and 1940, pursuant to requests from the U. S. Army Engineer Corps, the Office of Stream Sanitation at Cincinnati undertook two special investigations on stream pollution. The first related to the North Canadian River in Oklahoma and Texas; the second had to do with the Grand (Neosho) River draining parts of four states, Kansas, Oklahoma, Missouri and Arkansas.

These special investigations dealt with, not only an analysis of and recommendation to alleviate stream pollution conditions, but with the need, value and effect of conservation storage and low flow control in relation to water supply and pollution abatement. Final reports were submitted to the Engineer Corps in January and August, 1940.

ACTIVITIES AT FIELD SUB-STATIONS

During November and December, 1940, nine sub-stations of the Ohio River Pollution Survey were continued in operation to complete field work in cooperation with State health departments and the Tennessee Valley Authority. These sub-stations were located at: Greensburg, Meadville and Pittsburgh, Pa., Charleston, W.Va., Columbus, Ohio, Louisville, Ky., Indianapolis, Ind., Nashville, Tenn. and Wilson Dam, Ala. (T.V.A. Station).

The majority of the field forces at present are concentrated at the central office in Cincinnati, Ohio and at two field stations, Indianapolis and Greensburg, with only one engineer at each of the stations at Charleston, Columbus, Nashville, Meadville and Louisville.

Despite reductions in personnel, field reports giving data on water supply, sewage and industrial waste disposal numbered 780 during December, making a total of 7,971 such reports completed during the entire period of the survey. The result of the increase in personnel during the past calendar year is reflected by the 5,450 reports submitted during 1940, as compared with 2,521 reports prepared during calendar year 1939.

As indicated by the accompanying tabulations, the water supply and sewage disposal studies were approximately 89% complete and the industrial waste studies 78% finished at the close of 1940. The status of completion on twenty drainage basins and the Main Ohio is given in Table 1.

All field work on sources of pollution from sewage and industrial wastes is scheduled for completion by March 31, 1941.

Table 1 - Status of Field Reports on Municipalities and Industries, by Major Drainage Basins, as of January 1, 1941.

	Communities Completed*			Industries Completed		
	Dec.1940	Total 1940	Per cent	Dec.1940	Total 1940	Per Cent
Watersheds Completed						
Big Sandy	0	0	100	0	0	100
Cumberland	0	112	100	0	13	100
Green	0	88	100	0	13	100
Guyandot	0	5	100	0	0	100
Hocking	0	30	100	0	5	100
Kanawha	0	111	100	0	3	100
Kentucky	0	0	100	0	0	100
Licking	0	0	100	0	0	100
Little Kanawha	0	17	100	0	3	100
Little Miami	0	0	100	0	0	100
Miami	0	1	100	0	2	100
Salt	0	30	100	0	28	100
Scioto	0	11	100	0	0	100
Watersheds Incomplete						
Allegheny	18	254	80	16	127	58
Beaver	8	43	57	9	79	67
Monongahela	5	323	89	6	70	63
Muskingum	0	153	100	3	91	98
Ohio (M&D)	53	250	80	22	164	51
Tennessee	101	276	80	1	111	99
Wabash	152	531	88	49	271	82
Totals 1940	337	2235		106	980	
Totals 1939	-	984		-	553	
Totals for Survey		3219	89		1533	78

* Each community represents two reports, one for water supply, one for sewage disposal.

CURRENT LABORATORY OPERATIONS

Total Volume-Nov. and Dec. Summary

Laboratory activity continued at full scale in both the upper and lower sections of the Ohio Basin in November, but were curtailed in December. Break-down of laboratory sampling follows:

	To Nov.30	Dec. 1-31	To Dec.31
Samples examined	62,992	2,631	65,623
Physical and chemical determinations	85,571	5,159	90,730
Bacteriological tests	29,541	1,021	30,562

The "Kiski" floating laboratory continued its operations, based at East Liverpool, Ohio. Through most of December systematic and intensive sampling of the main Ohio River and immediate tributary areas from Wheeling to Pittsburgh was carried out.

Early in November, a mobile trailer unit proceeded to the Niles-Youngstown area, to institute special taste and odor observations in the Beaver-Mahoning Basin. This special investigation was in cooperation with the States, cities and industries in this highly industrialized basin where interstate waters are seriously affected by stream pollution. Excellent results were obtained.

Late in December 1940, the Greensburg mobile trailer unit proceeded to Charleston, W. Va. to carry on special taste and odor studies authorized for the Kanawha Basin. Plans are complete for starting this survey in January. Corrective

measures have been taken at certain industrial plants, which the survey last winter demonstrated were responsible for the major part of the taste and odor troubles experienced in the lower Kanawha and the tributary area of the Ohio River.

Two trailer laboratories will continue in operation along the main Ohio River in both the upper and lower sections, in order to record high water conditions during the winter and spring months.

Late in December, plans were formulated to transfer for the period January-March two mobile trailer units to the Cumberland and Tennessee Basins. Trailer units from the upper and lower reach are scheduled for duty in this territory, all laboratory activities except in connection with the acid stream study at Morgantown, West Virginia, to be completed by March 31, 1941.

Biological Studies

During November the field parties at work in the Cumberland and Tennessee River Basins, on biological studies of aquatic life returned to Cincinnati. Here a large amount of laboratory work must be performed and will be carried on simultaneously with the preparation of the final report.

EPIDEMIOLOGICAL STUDIES

Late in November, 1940, there occurred an outbreak of gastroenteritis involving nearly half the inhabitants of a small municipality in Kentucky. The unit was fortunate in being on hand while the outbreak was at its height. The large number attacked and the short course indicated that water was the probable vehicle. This conclusion was strengthened by a canvass of persons using and those not using city water habitually. Of the latter, very few were attacked and most of these were found to have taken some city water prior to their attack. In one family which used only boiled water several cases occurred after the outbreak had practically subsided and it was found that there had been lavish use of ice cubes made with unboiled city water.

Laboratory results were at first disappointing. No residual chlorine was found in the distribution system or in water from the treatment plant but coliforms and late or non-lactose fermenters were also absent. However, several water samples and stool specimens showed a pseudomonas which must be regarded with suspicion, in view of this prevalence at the time of the outbreak. Intensive laboratory studies of this organism are under way.

Diarrhoea and enteritis mortality studies over the Ohio Basin have so far shown very little relationship between the source of the water supply and the extent of mortality. In

the Ohio River Basin a fairly definite relationship does appear between latitude and mortality - the southerly communities showing the higher mortality regardless of the source. Possibly economic factors are responsible here.

In the literature an occasional reference may be found to the toxic properties of certain algae. The unit, cooperating with the Biological Division of the Stream Pollution Investigations Station has gathered samples of algae when these were found in relatively pure culture in nature. One sample of Microcystis aeruginosa was found to be quite toxic for mice. More of the material was collected and preserved by freezing for study during the winter. It was found that freezing greatly increased the toxic action - possibly by breaking the cell walls of the algae and liberating the toxic element. Since it is practically impossible to collect bacteria-free algae in nature, the effect of bacterial action cannot be lightly ruled out. However, it has been found that bacteria-free filtrates and autoclaved samples are still toxic - suggesting that the toxic element is a fairly stable chemical compound. The problem manifestly does not lie entirely in one field but requires the close cooperation of biologist, bacteriologist and chemist.

INDUSTRIAL WASTES AND THE OHIO RIVER POLLUTION SURVEY

A Symposium - Continued

In preparing the September - October, 1940 issue of the Activities Bulletin, field personnel assigned to industrial wastes were invited to contribute. The result was a symposium too large for inclusion in one issue. We are glad of the opportunity of presenting the remaining articles in this issue.

Some Notes on Industrial Survey Field Work in Metropolitan Pittsburgh Area

E. H. Pearl,
Asst. Public Health Engineer

In the Pittsburgh metropolitan area, comprising a section approximately twenty miles in radius centered about the confluence of the Monongahela, Allegheny and main Ohio Rivers, are located many industries which, because of their magnitude and controlling organization, require special field survey methods.

This is particularly true of those plants engaged in defense activities where, in most instances, guards have been increased and much more stringent regulations placed into effect, controlling admission and activities of outsiders entering the plants. However, all this has caused little difficulty for the field engineers. In every instance, direct application to the

highest official of the company available, and a resulting conference, has secured entry into, and cooperation of, the plant. At local independent plants, this may usually be secured at the time of the first visit. Where plants are subsidiaries of a large parent organization, it has been found best to first contact this organization. This was done in connection with one large corporation which has many plants in the Pittsburgh area and a number more in this section outside the area. At a conference with one of the chief officials, methods and purposes of the Survey were discussed. This official, after gaining an understanding of the survey, in turn contacted subsidiary operating companies, outlining the program and requesting their cooperation. Certain company officials were named as contact men to be visited prior to plant surveys. These men, upon being contacted, have furnished either one or two employees to accompany the field engineer to the local plant where one or more plant men joined the group and then the survey made. In this case it was stated that all quantitative data would be furnished through the main office. Consequently, upon completion of the plant survey, the field engineer has submitted to the company representative a list of supplementary questions or requests for additional information to be compiled by and through the Corporation office.

Industrial Waste Treatment

M. LeBosquet
Public Health Engineer

The Ohio River Pollution Survey is being made, in accordance with instruction, "... with a view of determining the most feasible method of correcting and eliminating the pollution...". In connection with industries, this view has required the collection of available information over the country on successful remedial measures for industrial waste pollution. Brief summaries of this information, which should be of considerable general interest, are presented:-

Meat Industry - Meat industry wastes are being completely treated although plants are few in number. These wastes are being treated by double filtration at Mason City, Iowa; multiple filtration at Fargo, North Dakota and activated sludge at Muncie, Indiana. Super-chlorination has been reported in use at Austin, Minnesota, and Grand Rapids, Michigan. The City of Sioux Falls, South Dakota, using trickling filters and activated sludge in series treats packinghouse wastes amounting to about 76 per cent of the total load with an efficiency of 96.2 per cent.

Milk - Complete treatment is practiced with milk wastes in a number of successful installations. Processes in commercial operation at milk plants of various kinds include septic tanks, trickling filters, activated sludge, Guggenheim process, and broad irrigation.

Cannery - Cannery waste treatment is usually of a partial nature with chemical precipitation popular. Secondary treatment, practiced in two places with domestic sewage is technically feasible but expensive due to the short operating season. Lagooning appears to be the only practical complete disposal method at the small rural cannery. Reduction in strength of liquid wastes by good housekeeping methods and separate slop systems with disposal of relatively dry waste material on land has been successful.

Brewery - Breweries, being located, as a rule, in large cities, have seldom required separate treatment works. However, complete treatment is technically feasible and brewery wastes are treated by the activated sludge process in Minster, Ohio and by trickling filters at Houston, Texas.

Distillery - Distilleries are required to dispose of concentrated wastes or thin stillage in practically all cases. Evaporation, stock feeding and sale to farmers are practiced, the latter two procedures being reliable only at small plants. Residual pollution load from evaporator condensate, washing, cleaning, sterilizing and spills consists of about 10 per cent of the total load and is seldom treated. Disposal practices include discharge to municipal sewers for treatment with domestic sewage, discharge to stock pens and broad irrigation.

Tannery - Treatment practiced at tanneries can, in general, be classed as partial or primary. However, with storage over low water periods, these methods have been effective. Treatment of wastes from a tannery on a very small stream may still be a problem.

Current treatment practices include evaporation of spent tan, natural evaporation of bleach liquors; mixing and two-stage settling of proportionate quantities of all objectionable wastes with sludge removal to beds after 24 hours quiescent settling; mechanical mixing with fill and draw settling; cascading of effluent over a series of steps; and storage of wastes in lagoons with discharge at high stream flows.

Paper Mill - Wastes from paper mills where no pulping or deinking processes are involved can be corrected to a large extent by changes within the mill itself. Remedial practices include: save-all and closed or partially closed system, sedimentation, coagulation and sedimentation, and ponding of beater washes with seepage to stream.

Pulp Mill - The treatment of wastes from pulping, deinking and other concentrated waste producing processes in the paper industry involve some of the most important technical and financial problems in the industrial waste field in which entirely satisfactory solutions are lacking.

Practices used singly or in combination include evaporation of concentrated waste liquor and burning, chemipulp process for reutilizing strong acid, thereby reducing total sulfur consumption, chip packing in the digesters to

expose a greater quantity of chips to a given quantity of acid at each cooking, efficient separation of liquor from stock at maximum concentration, neutralization of liquor and reclamation of calcium monosulfite, black liquor recovery processes, and reuse of weak wash liquors. Long time impoundment of pulp mill waste in very large lagoons is practiced. Experience has shown this practice to be successful until lagooned area is exhausted.

Treatment of straw pulp waste by chemical precipitation has recently been instituted at Circleville, Ohio. Processes such as the Howard, Tomlinson and others are in various stages of development or demonstration.

Textile - Treatment of textile wastes has been confined largely to chemical precipitation. This treatment with equalization of flow, is also used as a pretreatment prior to discharge to a municipal treatment plant.

Practices consist variously of flocculation by air jets, spray aeration, fill and draw or continuous chemical precipitation, equalization of flow, bleaching and cascading of final effluent. One plant follows chemical precipitation with coke trickling filters and final sedimentation. Sludges are filter pressed.

Treatment of pretreated textile wastes along with municipal sewage in activated sludge plants is practiced.

A year's operation of an experimental trickling filter indicated that settled mixtures of sewage and wastes are amenable to biological treatment.

By-product Coke - The removal of phenols from coke wastes has received considerable attention following public water supply taste and odor troubles. Efficient phenol recovery units are now in successful operation. Oxygen requirements of the wastes have received less attention. These requirements can be reduced by return and reuse of excess quenching water, and recirculation of final cooler water. A gravity oil separator on the light oil and crude still waste lines is desirable and refining still residue should not be discharged to the sewer.

Oil Refinery - Refinery wastes are dealt with at the source within the plant as regards taste and odor producing substances and oil emulsions and by gravity separators on the main sewer as regards escaping oil.

Remedial measures in reducing the concentration of phenol and other taste producing substances have been effected by segregation and separate disposal of highly concentrated components and through changes in the treating processes. Oxygen requirements of the wastes have received little attention. Rapid development in refinery processes has complicated waste problems.

LOW FLOW CONTROL MEASURES IN OPERATION AND PROPOSED IN THE UPPER OHIO BASIN.

A - Tygart Dam & Reservoir on Monongahela River

Tygart Dam on the Monongahela River was constructed as a unit in the War Department's Ohio River flood control program. Operation the past two years has included low critical flow control with provisions for 340 c.f.s. minimum at Lock #8, Monongahela River (July-December). This regulation has demonstrated its value not only as an aid to navigation, but also to improved water supplies and general stream sanitation. Mr. D. D. Rait of the Pittsburgh District Office, U. S. Army Engineers, has recently discussed the operation of Tygart Dam for the years 1938 and 1939 in an enlightening paper entitled "Water Quality Control by Flood Control Reservoir Operation", presented at Pittsburgh, November 12, 1940 before the Engineers Society of Western Pennsylvania.

Excerpts from Mr. Rait's Paper on Water Quality Control

"..... 2. As the result of investigation of the sources, types and degree of pollution in the upper Ohio Basin, which includes the Allegheny and Monongahela Rivers, it is apparent that the pollution is of long standing and is deep seated. A large part of the area is concerned with coal mining and metallurgical industries. Liquid wastes result and find their way into the stream. Acid mine drainage is the principal type of pollution. Elimination of pollution at individual sources is difficult and expensive. Some progress is being made by treatment of sewage, treatment of industrial wastes and sealing of abandoned mines. Further progress is to be expected. However, the region should and will continue as a principal source of coal production for hundreds of active mines' pollution will continue to be a problem for a long time to come.

"3. The provision of storage on the headwaters for flood control suggests the possibility of a planned operation which might provide water for diluting the various pollutive substances

to such a degree that they will be rendered impotent. If possible, the acidity would be neutralized and the hardness materially reduced. A practical example of such operation is the Tygart River Reservoir.

"4. The Tygart Reservoir, constructed and operated by the U. S. Army Engineers, has been in service since January 1938. It is located on the Tygart River near Grafton, West Virginia, lying about 27 miles above the head of the Monongahela River and about 150 miles above Pittsburgh. Operated primarily for flood control and navigation, water supply, the Tygart Reservoir has successfully served these purposes since its completion and, in addition, has been effective in providing a measure of pollution abatement by dilution.

"5. Reservoir operation provides for the maintenance of minimum practical pool elevations during the dangerous flood season. Late each spring, however, storage of peak discharges is begun so that 100,000 acre feet of water is impounded by July 1st. Studies have shown that this does not materially impair the efficiency of the reservoir as a flood control measure because the lower flood frequencies, lower runoff factors and more localized nature of flood producing storms prevail in this area throughout the summer and autumn months. The 100,000 acre feet of water so impounded is sufficient to insure a constant discharge of 340 second feet at Lock No. 8, Monongahela River, throughout the period July 1st-December 15th.

"6. This seasonal storage in the Tygart Reservoir and the regulation during the low water periods is based primarily on the demand for the Monongahela River navigation. However, any increase in low water flow constitutes a major benefit to industry and to the general public in the Monongahela Valley. Deplorable conditions existed in the Monongahela River during the drought of 1930, constituting a serious menace to public health. The improved condition of the river water since the Tygart Reservoir has been placed in operation has been quite apparent at the waterworks and industrial plants along the Monongahela River....."

"13. The total water demand at and above Pittsburgh exceeds 2,000,000,000 gallons per day. Of this amount approximately 32,000,000 gallons per day are treated for domestic consumption on the Monongahela River reach between Fairmont and Pittsburgh. On this same reach during the year 1939 approximately 1,145,000,000 gallons per day were used for cooling purposes by industry, along with 33,000,000 gallons per day treated for boiler feed water.

"14. A combined adjustment of the water available for consumption with the reduction in acidity and hardness affected by the Tygart Reservoir and the unit costs of water treatment have produced a total monetary benefit for the years 1938 and 1939 equal to approximately $280,000.00.

"15. This figure included only the estimated savings in actual water treatment. No attempt has been made to assign monetary values to various other factors such as the increased oxygen carrying capacity which aids in the assimilation of domestic sewage and other organic and inorganic wastes. The possible effect on the Ohio River below Pittsburgh has also been omitted. The estimates of monetary benefits are, therefore, quite conservative....."

"21..... The low water regulation feature of the flood control reservoirs, therefore, is an important by-product of the primary function of flood control and can play an important part in alleviating the pollution of the rivers in this area."

B - Low Flow Control - Mahoning River

The Mahoning River flows from Ohio into Pennsylvania to join the Shenango River, thus forming the Beaver River about 20 miles above the mouth of that stream. In Ohio the basin is highly industrialized.

The question of low flow control on the Mahoning was discussed by Mr. F. H. Waring, Chief Engineer of the Ohio State Health Department and a member of the Upper Ohio-Beaver Drainage Basin Committee. The paper, with special reference to industrial water supplies and stream sanitation, was presented at the Pittsburgh meeting of the Upper Ohio Drainage Basin Committee of the National Resources Planning Board. A portion of Mr. Waring's excellent paper is reproduced here since he has outlined so clearly the substantial benefits of low water control in relation to public and industrial water supplies and the disposal of sewage and industrial wastes.

Mr. Waring's paper is titled "Proposed Reservoir Construction for Low Flow Control of Mahoning River in Ohio of Particular Importance in Relation to National Defense".

Excerpts from Mr. Waring's Paper on Mahoning River

"The proposition of constructing reservoirs to hold back excess or flood flows and release them during periods of low flow, thus regulating or controlling the low flow of the stream, is not new. Probably the first reservoir for such a purpose, at least in this part of the country, was the Milton Reservoir constructed on the Mahoning River in Ohio in 1916; then came the Pymatuning Reservoir constructed on the Beaver watershed in Pennsylvania and Ohio and completed in June, 1933. This latter project had for its primary purpose the minimizing of flood damage and the secondary purpose of furnishing dilution water for sewage and industrial wastes in the Shenango River Valley in Pennsylvania. A similar reservoir was constructed in 1938 on the Tygart River in West Virginia to furnish sufficient water for navigation in the upper Monongahela River in West Virginia and Pennsylvania.

"For a number of years there has been under consideration the building of one or more reservoirs in the Mahoning River watershed in Ohio for increasing the low flow, especially for that stretch of the river extending through the heavily built-up area from above Warren to below Youngstown.

"The benefits to be derived from such a proposal for regulating and increasing the low flow of Mahoning River in the Warren-Youngstown district are many. Probably the most important of such benefits at the present time is that of furnishing industry with sufficient water supply to carry on important operations in the manufacture of steel and steel products so vital to a successful carrying on of national defense contracts involving armament and ordinance equipment.

"Other benefits which might be considered more important in normal peace time are (a) improvement of water quality for sources of municipal and industrial water supply, (b) the increase of dilution water for sanitation purposes, making possible easier treatment and disposal of sewage and industrial wastes, (c) although low flow control reservoirs may not be intended primarily for flood protection, nevertheless they exercise such a benefit by reducing the stages of runoff that otherwise would occur; and (d) should it become advisable to extend navigation of Ohio River up the Beaver and Mahoning Rivers, these low flow control reservoirs would furnish the necessary water for operation of the navigation locks and dams.

"Discussion of Low Flow Control Benefits

"Importance of Increased Flow from an Industrial Standpoint

"The industrial district of the Mahoning River Valley extends, roughly, from Newton Falls to the Pennsylvania-Ohio state line, approximately forty miles in length and includes about forty industrial plants. Along the river in this distance there resides a population of nearly 400,000 people. By far the most important industry in the district is the production of iron and steel. It is estimated that the sixty steel mills in the so-called "Youngstown Region", including both the Mahoning and Shenango Valleys, represent an investment of over a billion dollars, with an annual capacity exceeding 8 million gross tons of pig iron, 10 million gross tons of steel ingots and castings and 13 million gross tons of rolled products....."

"These industrial plants use large amounts of river water estimated to be in the vicinity of 800 million gallons daily.(3) The watershed available for supplying the flowage in Mahoning River above Youngstown is about 900 square miles. The river flow averages about 550 million gallons daily; however, the flow during the dry weather months averages much lower. There have been many months from 1930 to date when the average flow was under 50 million gallons daily. It is, therefore, obvious that the normal flow of the river during low flow months has been entirely inadequate to take care of industrial water supply demands.

"The inadequacy of the river flow in dry weather times is further reflected by the fact that for months at a time the temperature of the river water at and below Youngstown is frequently in excess of 100°F. by reason of the excessive reuse of the water by industry for cooling purposes. It is estimated that the entire flow of Mahoning River during dry weather periods is reused from fifteen to twenty times for industrial purposes in the Youngstown district alone. Unless substantial increases in dry weather flow of the stream can be effected, the steel industries requiring large quantities of cooling water may be forced to curtail operations. This situation is particularly true at the present time when practically all of the steel plants in the Mahoning Valley are operating at 100 per cent capacity, the bulk of which operations has to do with the national defense program of manufacture of special steels for armament and ordinance equipment.

"Need for Improvement of Water Quality for Sources of Municipal and Industrial Water Supply. There are six municipalities, each with a population in excess of 10,000, located adjacent to Mahoning River in Ohio. Five of these municipalities, having a total population of about 275,000, are grouped in the relatively short twenty mile stretch of the river from Warren to Struthers, inclusive....."

"For many years Youngstown and Niles, with a combined population of nearly 180,000 people, experienced tremendous difficulties in procuring domestic water supply of safe quality and usable character taken directly from the river itself. In 1932 these two cities combined to form the Mahoning Valley Sanitary District in the development of a surface water supply from a storage reservoir on Meander Creek, a clean tributary of Mahoning River, and by means of a modern water treatment plant these cities are now afforded an excellent domestic water supply of safe quality and ample quantity. The city of Warren, with a population of about 45,000, still obtains its municipal water supply directly from Mahoning River; and, although equipped with a modern water purification and softening plant, Warren is experiencing serious difficulty in continuing to produce safe, potable and palatable water from a stream increasingly being used for industrial purposes. The time has practically arrived when Warren must seek another source for its domestic water supply....."

"..... The concentration of untreated sewage in the Youngstown district introduces severe burdens upon downstream waterworks intakes, especially during times of rises in the river which exert a flushing action upon the stream as a whole."

"..... With sustained flows which can be guaranteed by low flow control, the water quality of the river can be greatly improved from the standpoint of alkalinity and hardness, possibly approaching the water quality obtained during the seasons of natural ample flow.

"Sanitation Requirements. It is estimated that there is discharged into Mahoning River in the short distance of twenty miles from Warren to Youngstown, inclusive, about 40 million gallons daily of untreated domestic sewage. If it were not for the coincident discharge of acid wastes from the steel mills, the river water would become offensive from the natural decomposition of the sewage matters. Such a situation was observed during the low flow period of 1930 when the operation of the steel mills was at a minimum due to depression conditions. Mahoning River through Youngstown in August, 1930, presented an extremely objectionable situation of a black appearing stream boiling with putrefaction, with resultant offensive sewage odors being given off.

"It is obvious that improvement of the river water without the increase of flow would be extremely difficult and very expensive. It would necessitate the complete treatment of all sewage and industrial wastes discharged into the stream. If a sustained flow could be maintained during dry weather months by control reservoirs, it is quite probable that the degree of sewage and industrial wastes treatment need only be partial.

Resultant savings in devices otherwise needed for complete treatment would go a long way toward justifying the expense of low flow control structures. It has been estimated that the cost of partial treatment of municipal sewage in the district is in the vicinity of $2,800,000, but that the cost of complete treatment for municipal sewage in the district would be in the vicinity of $6,000,000; both of these costs do not include the necessary intercepting sewers and collecting appurtenances.(5) ....."

"Proposed Berlin Reservoir. The site of the proposed Berlin Dam is located on Mahoning River about six miles upstream from the present Milton Dam near the Portage County-Mahoning County line. This location has been agreed upon by several investigators as the one best adapted for maximum storage and withdrawal of water during times of low flow. Those who have studied this dam site have not agreed as to the economical elevation of flow line to be established by the structure. Four different elevations have been talked about, namely, elevations 1010, 1020, 1027, and 1031. Obviously, the storage benefits are greater with the highest elevation of flow line to be established but a corresponding higher cost of reservoir is also indicated. In the report of the Ohio State Planning Board (5) elevation 1020 was selected as the economical elevation. In accordance with this condition, the available storage would be 11.7 billion gallons with a net safe yield of 60 million gallons daily, and costing approximately $2,040,000....."

"Proposed Mosquito Reservoir. The location of the dam to form Mosquito Reservoir is on Mosquito Creek about five miles north of an east and west line through the center of Warren. Four investigators have reported upon this reservoir site and all recommend the dam at the same location. Apparently the economical capacity of this reservoir is about 36 billion gallons at flow line elevation 908, providing a net safe yield of about 45 million gallons daily, and costing about $3,456,000. The relatively small safe yield in comparison to the large storage capacity of this reservoir is due to the rather small watershed area (96.8 square miles)....."

"Recommendations

"Based upon a study of use of Mahoning River for domestic and industrial water supply, for sewage and wastes disposal, and for other corollary benefits, it would appear that the minimum requirement of water flow in the Mahoning River at Youngstown should be in the vicinity of 300 million gallons daily. If such minimum flow were guaranteed there would be six times as much flowage as that normally present during dry weather at the present time. The increased flow should serve to take care of immediate needs as hereinbefore described.

"To effect this guaranteed minimum it would be necessary to build two low flow control storage reservoirs, preferably the suggested Berlin and Mosquito Reservoirs. The combination of the proposed Berlin, existing Milton reservoirs, together with the proposed Mosquito Reservoir, affords a net safe yield of 134 million gallons daily every day in the year, but, taking into account the fact that release of water from these storage reservoirs is not necessary except during dry weather months, it is possible to guarantee from this combination a minimum flow of 300 million gallons daily. These two proposed reservoirs, according to estimates of the State Planning Board Report of 1936 (5), should cost in the vicinity of $5,500,000.

"As already pointed out, the benefits in stream sanitation by constructing only partial sewage and wastes treatment instead of complete treatment, might be valued at approximately $3,000,000 in costs of treatment works alone. Additional monetary benefits are evident from an improved domestic water supply available to the City of Warren by reason either of improved quality in the main stream where the present intake is located or by reason of possible construction of auxiliary intake or conduit from the Mosquito Reservoir. Valuable benefits resulting from savings in present corrosion of industrial water pumping and piping facilities would likewise result. If the other corollary benefits are in turn evaluated, it is quite likely that the costs of the guaranteed minimum flow of 300 million gallons daily would easily be realized in a comparatively short time in the Youngstown District alone, not to mention the resulting benefits of the increased low flow upon waterworks and industrial intakes in the Beaver River Valley in Pennsylvania....."

"Conclusion

"In conclusion, it would seem that an immediate construction of low flow control reservoirs is warranted in the interests of assuring adequate and proper industrial water supply for industry in the Mahoning Valley now engaged to a very great extent in manufacture of steel and steel products making up an important portion of contracts that are part of the national defense program."

"References

"(3) Report of the Chief Engineer upon Source of Water Supply, Mahoning Valley Sanitary District, W. H. Dittoe, December, 1926....."

"(5) A Tentative Plan for the Control and Utilization of Water Resources in the Mahoning Watershed, Ohio State Planning Board, June 19, 1936."

STREAM POLLUTION STUDIES IN THE PACIFIC NORTHWEST

Paul Seufer, who did such a splendid piece of work on the study of Administration of Stream Pollution Abatement in the Ohio Basin during the six months' period, July to December 1940, in which he was stationed in the Cincinnati office of the U. S. Public Health Service as Assistant Sanitary Engineer (R), has recently returned to his former position at Seattle, Washington, with the Washington State Department of Health.

He advises that he is now serving as a member of the Interstate Technical Advisory Committee in connection with the co-operative project between the States of Oregon and Washington on a proposed stream pollution study of the Columbia River. His work and experience on the Ohio River Pollution Survey should be of value as these pollution studies get underway.

ACID MINE DRAINAGE STUDIES

Assistant Sanitary Engineer (R) Paul Haney in December, 1940 returned to his regular teaching work at the State University and the State Department of Health at Lawrence, Kansas.

His excellent summary report on Acid Mine Drainage in the Ohio Basin was completed in December. It sets forth the results of his eight months' work while in charge of the Pittsburgh Office, to which this detailed study on Acid Mine Drainage in the Ohio River Basin was assigned.

Acid mine drainage has been studied in a comprehensive manner over the entire Ohio Basin and its relation to the bituminous coal mine industry since the mining of coal was begun. The effect, decade by decade, of the acid drainage on the streams in this basin, particularly the Allegheny, Youghiogheny and Monongahela Rivers has been ascertained. The economic effects upon water uses and the effect of sealing abandoned mines in the direction of reducing the acid load on the streams has been determined. Before leaving the Survey, Mr. Haney had the opportunity of discussing the broad scope of these studies, together with the objectives in the work, with a representative committee of the American Mining Congress which was interested in the whole problem as it related to mining practices.

The Pittsburgh Office of the U. S. Army Engineers has been exceedingly helpful in making available reports and studies which have been carried on by the Engineer Corps in the Pittsburgh District from time to time over the past twenty-five years on Acid Drainage and its effect upon navigation and industry.

Mr. Haney's headquarters were at the Regional Office of the Public Health Service project for Sealing Abandoned Coal Mines. All available data relative to acid loads on the streams before and after sealing were used.